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EFFECT OF CROP ROTATION ON THE CONTROL OF WILD OAT IN WHEAT IN UPPER EGYPT

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Abstract

Long term study in Shandaweel Station during the period from 1991 to 1995 on the role of four-year crop rotation for wild oat control in wheat fields with four crop sequences and four weed control methods was carried out in naturally heavy infested soil with oat seeds (average of 624 wild oat seedlings/m2 in 1991/92 winter season). Striking findings were obtained indicating that crop sequences including berseem with wheat or berseem in three years sequence followed with wheat were less favorable for wil oat growth and exhaust wild oat seed bank accompanied with high wheat yield and yield components with less contaminated wheat grains with weed seed than in the case of non rotated wheat. Thus, the present study recommended to use crop sequence of berseem/wheat/bersem followed by handweeding or using herbicides for controlling wild oat for preventing renewal of wild oat contamination from other sources. Such system exhaust the reserve of wild oat seeds in soil and maintain wheat productivity with cutting herbicide use.

INTRODUCTION

This paper is the first in a series of investigations describing wild oat and other weed control in winter cereals and other winter crops within the project sponsored by European Union through Nile valley project/ICARDA. The purpose of the project is to control wild oat in particular and other weeds in general in wheat, barley, lentil and faba bean. This paper will be followed by a series of papers on integrated weed management which includes topics such as the role of survey of weeds, crop rotation in wheat and faba bean fields, source of weed contamination, adoption of wild oat control packages of wheat by farmers, the economic impact of wild oat control on wheat productivity in Egypt, weed control in barley, faba bean and lentil ... etc .

Concerning the effect of crop rotation on wild oat management, many researchers found that the increase of wild oat infestation in wheat fields comes from the use of bad strategy such as sowing wheat annually without any rotated system and inadequate control, which lead to the increase of wild oat seeds in soil (Dvorak and Krajcir, 1981 and Tu., 1989). Wilson and Phipps (1985) indicated that crop rotation system using cutting crops i.e.

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MATERIALS AND METHODS

Four year crop rotation experiment started in 1991 and continued to 1995. Treatments were sixteen represent that combination of four crop sequences and four weed control methods as shown below. This four-year crop rotation were carried out in Shandawell Agricultural Research Station in naturally infested silty clay soil with 624 wild oat seedlings/m2 as average in the start season in 1991/92.

1991/92	1992/93	1993/94	1993/94
Wheat	**Wheat**	Unweeded	**Wheat**
1- Unweeded	Unweeded	Handweeded	Unweeded
2- Handweeded	Handweeded	Grasp	Unweeded
3- Grasp	Grasp	Grasp+Handweeded	Unweeded
4- Brominal	Grasp+Handweeded	**Berseem**	Unweeded
Berseem	**Berseem**	Unweeded	**Wheat**
5- Unweeded	Unweeded	Handweeded	Unweeded
6- Handweeded	Handweeded	Unweeded	Unweeded
7- Basagran	Unweeded	Unweeded	Unweeded
8- Fusilade	Unweeded	**Berseem**	Unweeded
Berseem	**Wheat**	Unweeded	**Wheat**
9- unweeded	unweeded	Handweeded	Unweeded
10- Handweeded	Handweeded	Grasp	Unweeded
11- Bsagran	Grasp	Grasp+Handweeded	Unweeded
12- Fusilade	Grasp+Handweeded	**Wheat**	Unweeded
Faba bean	**Berseem**	Unweeded	**Wheat**
13- Unweeded	Unweeded	Handweeded	Unweeded
14- Handweeded	Handweeded	Unweeded	Unweeded
15- Igran	Unweeded	Grasp+Handweeded	Unweeded
16- Fusilade	Unweeded		

Fertilizer, irrigation and pest control were managed in accordance with the local recommedations for each crop. The treatments were included in a nested split design with 4 replications. The size of each plot was 10.5 m2.

Date recorded were :

1. Fresh weight of wild oat g/m2 at 70 days after sowing.
2. Grain yield (t/ha).
3. Number of wild oat seeds in wheat grains.

Data was subjected to the proper statistical analysis according to Steel and Torrie (1980) and the L.S.D. test at 0.05 level of significance was calculated.

RESULTS AND DISCUSSION

1991 / 92 season

The results of 1991/92 season as the start year indicated that wild oat infestation was estimated in wheat field by 624 seedlings and 853 gm/m2. Handweeding twice and Grasp could not control more than 52.5 and 52.9 precent of wild oat respectively. The production of wheat was relatively low due to the heavy infestation of wild oat. The previous treatment gave 1.63 and 1.559 t/ha a scompared with 0.602 t/ha for the check treatment (Table 1). Such results are similar to those obtained by sutton (1987), Rolaj (1987) and Al-Marsafy *et al.* (1992).

Table 1. Effect of weed control treatments on wild oat control and wheat yield in Shandaweel, (1st year of four-year crop rotation, 1991/92).

Treatments	% of wild oat control	wheat yield t/ha
Grasp	52.9	1.559
Handweeding	52.5	1.603
Unweeded	0	0.602
L.S.D. 5%		0.502

1992/93 season:

In 1992/93 seaosn, results in Table 2 showed that the highest pecentages of wild oat control (99.2%, 98.9%) were obtained from wheat plots of handweeding or treated with Grasp and previously cultivated with berseem in the pervious winter crop (1991/92) as compared with untreated plots of wheat in two sequent seasons.

The wheat grain yield tended to increase with these treatments by 152 and 170 percent. Grasp was useful in decreasing wild oat population with integration

Table 2. Effect of crop sequences and weed control treatments on wild oat control and wheat yield at Shandaweel, 1992/93 season (Second year of four-year crop rotation).

Weed control treatments		Wild oat weight		Wheat grain yield	
Preceding winter crops (1991/92 season)	Wheat (1992/93 season)	(g/m2)	Control %	t/ha.	% of check
Wheat:					
Unweeded	Unweeded	1255.5	0.0	2.130	100
Handweeding	Handweeding	18.5	98.5	3.999	188
Grasp	Grasp	124.3	90.1	4.428	208
Brominal	Grasp + Handweeding	173.3	86.1	4.642	218
Berseem:					
Unweeded	Unweeded	153.5	87.8	4.344	204
Handweeding	Handweeding	9.8	99.2	5.368	252
Basagran	Grasp	13.8	98.9	5.761	270
Fusilade	Grasp + Handweeding	24.0	98.1	5.320	250
L.S.D.		1022		1.452	

Table 3. Effect of crop squences and weed control treatments on wild oat control, grain yield and percentage of infestation by wild oat and bind weed in wheat grain yield (3rd year of four - year crop rotation at Shandaweel) 1993/94 season..

Crop sequence & weed control methods			Wild oat weight		Wheat grain yield			
Preceding winter crops		Wheat				%	No. of weed seeds /200 g wheat	
1991/92	1992/93	1993/94	g/m2	Control %	t/ha.	of Check	Wild oat original	Bindweed original
Wheat:	Wheat							
Unweeded	Unweeded	Unweeded	4954	0.0	0.300	100	25.00	23.75
Handweeding	Handweeding	Handweeding	861	82.6	1.524	508	18.25	22.75
Grasp	Grasp	Grasp	1817	63.3	1.515	505	11.25	42.50
Brominal	Grasp + H.W	Grasp + H.W	929	81.2	1.195	398	18.75	26.25
Mean			2140	56.8	1.133	378	18.31	28.81
Faba bean:	Berseem:							
Unweeded	Unweeded	Unweeded	176	96.4	3.932	1311	4.00	41.00
Handweeding	Handweeding	Handweeding	164	96.7	4.714	1571	6.00	13.75
Igran	Unweeded	Grasp	140	97.2	3.500	1167	1.75	27.50
Fusilade	Unweeded	Grasp + H.W	187	96.2	4.429	1476	3.25	13.75
Mean			167	96.6	4.144	1381	3.75	24.000
L.S.D.	Between A		1213		0.680		3.82	N.S
	Between B within A		1538		0.764		N.S.	N.S

A = Crop sequence.

B = Weed control treatments.

system with berseem. These results mean that using berseem as cutting crop in the preceding winter season can exhaust wild oat seeds in soil in addition to improving soil fertility which in turn decreases wild oat competition (87.8%) and increasing grain yield by (104 %) as compared with untreated plots of wheat in two sequent seasons. At the same time, using handweeding or Grasp in the preceding winter season in wheat once and again in the second season was to be useful in decreasing wild oat competition by 98.5 and 90.1% increasing grain yield by 88 and 108%, respectively.

In 1993/94 season:

A. Effect of crop sequences on wheat and associated wild oats:

Data in Table 3 showed that wild oat infestation in unweeded control treatment in non rotated wheat (W/W/W) was 4954 gm/m2 and decreased significantly to only 175 gm/m2 or 96.4% in unweeded wheat rotated with faba bean/berseem/wheat (F/B/W). Handweeding of wild oat in (F.B.W.) rotation was more efficient than in (W/W/W) rotation. Wheat yield tended to increase from 0.3 t/ha in unweeded treatments (W/W/W) rotation to 1.524 and 4.714 t/ha in hand-weeding in (W/W/W) and (F/B/W) rotation, respectively. The integration between Grasp use and handweeding is more useful than using Grasp only. Wheat grain yield was more exposed to contamination by wild oat seeds in non rotated wheat (W/W/W) than rotated wheat (F/B/W).

B. Effect of crop sequences on wild oat and berseem:

Data in Table 4 showed clearly that wild oat weight decreased with berseem cutting. Wild oat weight was 4954 g/m2 in non rotated wheat (table 3) and decreased to 197 gram in 2nd cut of berseem growing in thses years and to 2307 gm/m2 in first cut in berseem/wheat/berseem rotation and decreased to 15 gm/m2 with using berseem for 3 berseem for 3 sequential years as a compared with handweeding in second cut. The pervious results suggest that the use of crop rotation for three years include faba bean/berseem/wheat or berseem/berseem with handweding and cleaning wheat seeds from wild oat seeds can success for solving wild oat problem without any use of herbicides. These results are similar those obtained by wilson and Phipps (1985) and O'Donovan (1988).

In 1994/95 season:

The effect of crop sequence and weed control methods on wild oat, wheat

Table 4. Effect of crop sequences and weed control treatments on wild oat control and berseem yield (3rd year of four-year crop rotation at Shandaweel) 1993/94 season.

Crop sequence & weed control methods			Wild oat weight (g/m2)		Berseem yield t/ha.			
Preceding winter crops		Berseem			Fresh weight		Dry weight at harvest	
1991/92	1992/93	1993/94	Cutting 1	Cutting 2	Cut. 1	Cut. 2	Grain	Straw
Berseem:								
Unweeded	Unweeded	Unweeded	334	197	17.61	27.95	0.116	3.124
Handweeding	Handweeding	Handweeding	97	15	14.32	35.57	0.122	3.283
Basagran	Unweeded	Unweeded	61	41	16.44	42.46	0.092	3.176
Fusilade	Unweeded	Unweeded	57	45	17.98	44.00	0.094	2.525
Mean			137	75	16.59	37.50	0.106	3.025
Berseem	wheat							
Unweeded	Unweeded	Unweeded	2307	140	8.76	36.81	0.105	3.395
Handweeding	Handweeding	Handweeding	2126	148	10.19	38.59	0.071	3.024
Basagran	Grasp	Grasp	1698	121	10.20	29.12	0.083	3.417
Fusilade	Grasp+H.W	Grasp + H.W	2089	112	7.89	28.16	0.114	1.101
Mean			2055	130	9.26	33.17	0.093	3.234
L.S.D.	Between A		1148	N.S	N.S	3.26	N.S	N.S
	Between B within A		N.S	N.S	N.S	10.73	N.S	N.S

Table 5. Effect of crop sequences and weed control treatments on wild oat and wheat yield, shandaweel, fourth year 1994/95 season.

Crop sequence & weed control methods				No. of wild oat panicles/m2	Weight of wild oat g/m2	Wheat yield	
Preceding winter crops			Wheat			No. of ears/m2	yield t/ha
1991 / 92	1992 / 93	1993 / 94	1994 / 95				
Wheat :	**Wheat :**	**Wheat :**	**Wheat :**				
Unweeded	Un.W.	Un.W.	Un. W.	259.3	1408	35.5	0.32
Handweeded	H.W.	H.W.	Un. W.	234.5	1264	73.3	0.48
Grasp	G.	G.	Un. W.	245.5	1520	46.3	0.31
Brominal	Grasp + H.W	G. + H.W.	Un. W.	167.8	1358	52.5	0.69
Mean				226.8	1387.5	51.9	0.45
Berseem :	**Berseem :**	**Berseem :**	**Wheat :**				
Unweeded	Un.W.	Un.W.	Un. W.	17.5	102	257.3	4.43
Handweeded	H.W.	H.W.	Un. W.	14.3	40	300.0	4.21
Basagran	Un.W.	Un.W.	Un.W.	10.0	13	336.3	4.80
Fusilade	Un.W.	Un.W.	Un.W.	14.5	76	273.5	4.68
Mean				14.1	57.8	291.8	4.53
Berseem :	**Wheat :**	**Berseem :**	**Wheat :**				
Unweeded	Un. W.	Un. W.	Un. W.	42.5	194	221.5	4.00
Handweeded	H.W.	H.W.	Un. W.	42.3	335	216.8	3.37
Basagran	G.	Un. W.	Un.W.	32.0	216	256.3	3.89
Fusilade	G. + H.W.	Un. W.	Un.W.	16.00	50	356.0	4.31
Mean				33.20	198.8	262.6	3.89
Faba bean	**Berseem :**	**Wheat :**	**Wheat :**				
Unweeded	Un. W	Un. W	Un. W.	129.5	881	87.5	0.85
Handweeded	H.W	H.W	Un. W.	162.0	1144	87.8	0.85
Igran	Un. W	G.	Un.W.	113.5	1042	81.5	1.09
Fusilade	Un. W	G. + H.W	Un.W.	113.0	778	72.5	1.93
Mean				129.5	961.3	82.3	1.18
L. S. D.Between A				37.8	279.0	39.4	0.48
Between B within A				N.S	N.S	N.S	0.61

Table 6. Effect of crop sequences and weed control treatments on wheat yield components, shandaweel, fourth year 1994/95 season.

Crop sequence & weed control methods				Weight of wheat plant (g)	Plant height in cm	Ear No/plant	Ear weight g/plant	Grain weight g/plant	100 - grain weight/g
Preceding winter crops			Wheat						
1991 / 92	1992 / 93	1993 / 94	1994 / 95						
Wheat :	**Wheat :**	**Wheat :**	**Wheat :**						
Unweeded	Un.W.	Un.W.	Un. W.	3.95	87.3	1.25	2.39	1.70	4.24
Handweeded	H.W.	H.W.	Un. W.	6.86	96.3	1.80	3.97	2.86	4.53
Grasp	G.	G.	Un. W.	5.66	93.0	1.65	3.21	2.26	4.36
Brominal	Grasp + H.W.	G.	Un. W.	6.35	102.5	1.78	3.63	2.59	4.46
Mean				5.71	94.8	1.62	3.30	2.35	4.40
Berseem :	**Berseem :**	**Berseem :**	**Wheat :**						
Unweeded	Un.W.	Un.W.	Un. W.	10.85	108.5	2.40	6.22	4.54	4.46
Handweeded	H.W.	H.W.	Un. W.	9.62	102.8	2.28	5.54	4.11	4.53
Basagran	Un.W.	Un.W.	Un.W.	10.41	106.3	2.23	5.96	4.43	4.63
Fusilade	Un.W.	Un.W.	Un.W.	10.53	108.5	2.20	5.05	4.47	4.45
Mean				10.35	106.5	2.28	5.69	4.39	4.52
Berseem :	**Wheat :**	**Berseem :**	**Wheat :**						
Unweeded	Un. W.	Un. W.	Un. W.	12.10	106.00	2.48	7.10	4.98	4.61
Handweeded	H.W.	H.W.	Un. W.	9.73	107.8	2.35	5.85	4.34	4.29
Basagran	G.	Un. W.	Un.W.	12.36	108.8	2.68	7.67	5.01	4.34
Fusilade	G. + H.W	Un. W.	Un.W.	10.72	106.00	2.33	6.11	4.52	4.70
Mean				11.22	107.1	2.46	6.68	4.71	4.49
Faba bean:	**Berseem :**	**Wheat :**	**Wheat :**						
Unweeded	Un. W.	Un. W.	Un. W.	8.79	105.5	2.18	4.72	3.42	4.60
Handweeded	H.W.	H.W.	Un. W.	6.72	95.5	1.70	3.82	2.81	4.32
Igran	Un. W.	G.	Un.W.	8.48	103.5	2.13	4.71	3.36	4.52
Fusilade	Un. W.	G. + H.W.	Un.W.	9.08	106.8	2.10	5.12	3.74	4.55
Mean				8.27	102.8	2.03	4.59	3.3	4.49
L. S. D. Between A				1.24	3.3	0.24	0.82	0.64	N.S
Between B within A				N.S	7.9	N.S	N.S	N.S	N.S

Table 7. Effect of crop sequences and weed control treatments on the degree of wheat grains contamination by weed seeds at harvest, fourth year shandaweel, fourth year 1994/95 season.

Crop sequence & weed control methods				No. of wild oat seeds/ 200 gm of wheat grains	No. of Bindweed seeds/ 200 gm of wheat grains
Preceding winter crops			Wheat		
1991 / 92	1992 / 93	1993 / 94	1994 / 95		
Wheat :	Wheat :	Wheat :	Wheat :		
Unweeded	Un.W.	Un.W.	Un. W.	55.75	108.75
Handweeded	H.W.	H.W.	Un. W.	60.75	70.00
Grasp	G. + H.W.	G.	Un. W.	68.75	154.00
Brominal	Grasp + H.W.	G. + H.W.	Un. W.	40.25	137.50
Mean				56.38	117.56
Berseem :	Berseem :	Berseem :	Wheat :		
Unweeded	Un.W.	Un.W.	Un. W.	10.75	24.00
Handweeded	H.W.	H.W.	Un. W.	12.25	24.00
Basagran	Un.W.	Un.W.	Un.W.	8.75	3.75
Fusilade	Un.W.	Un.W.	Un.W.	4.50	7.00
Mean				9.06	12.31
Berseem :	Wheat :	Berseem :	Wheat :		
Unweeded	Un. W.	Un. W.	Un. W.	11.50	16.50
Handweeded	H.W.	H.W	Un. W.	10.50	26.00
Basagran	G.	Un. W.	Un.W.	9.25	40.25
Fusilade	G. + H.W.	Un. W.	Un.W.	11.00	24.50
Mean				10.56	26.81
Faba bean:	Berseem :	Wheat :	Wheat :		
Unweeded	Un. W.	Un. W.	Un. W.	19.00	64.50
Handweeded	H.W.	H.W.	Un. W.	56.25	79.25
Igran	Un. W.	G.	Un.W.	35.00	83.25
Fusilade	Un. W.	G. + H.W.	Un.W.	40.25	27.25
Mean				37.63	63.56
L. S. D. Between A				17.31	43.08
Between B within A				N.S	N.S

grain yield, yield component and the degree of wheat grains contamination by wild oat and weed seeds in wheat in the fourth year of crop rotation are shown in tables 5, 6 and 7.

Data in Table 5 showed that number of wild oat panicles and weight of wild oat in non rotated wheat for three years (W/W/W) in which number of wild oat panicles and wild oat plants weight were 259.3 number and 1408 g/m2, respectively, meanwhile the lowest values were obtained from berseem/berseem/berseem sequences preceded wheat or berseem/wheat / berseem preceded wheat sequences followed by faba bean/berseem/ wheat. The number of wild oat panicles and wild oat plants weight were decreased by 93.8, 95.8 and 85.4, 85.7 and 42.9, 30.7 percent, respectively. Such sequences were accompanied by an increase in wheat grain yield to 4.53, 3.89, 1.18 t/ha as compared to 0.45 t/ha for (W/W/W) sequence. In general the increases in wheat grain yield were attributed to the increases in different attributes of yield components (Table 6).

The effect of crop sequence on wheat seed contamination by wild oat and bindweed seeds results in table 7 indicated that the three crop sequences, B/B/B or B/W/B or F/B/W decreased wild oat seeds by 83.9, 81.3 and 33.3 percent and bindweed seeds by 895, 77.2 and 45.9 percent as compared with non rotated wheat, whereas different weed control treatments did not show any significant differences with any crop sequence. It can be concluded from this long term study that crop sequence which includes berseem as cutting winter crop is less favourable to wild oat growth and can exhaust wild oat and bindweed seed reserves in soil. Thus, crop sequence which includes berseem altermating with wheat from year to another is considered as a feasible sequence to be followed by farmers integrated with handweeding or herbicides for wild oat control and prevent any renewal of infestation by wild oat seeds from other sources. Such results are similar to those obtained by Wilson and Phipps (1985) and O'Donovan (1988), Tu (1989) and Dvorak and Krajcir (1981).

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تأثير الدورات الزراعية على مكافحة الزمير فى القمح بمصر العليا

حافظ طه المرصفى ، الحسانين الشربينى حسانين

قسم بحوث مقاومة الحشائش-معهد بحوث المحاصيل الحقلية-مركز البحوث الزراعية-الجيزة مصر .

تم إجراء دراسة طويلة المدى من خلال مشروع مكافحة الزمير فى القمح ببرنامج وادى النيل بمحطة بحوث شندويل فى ما بين الفترة من أعوام ١٩٩١ حتى ١٩٩٥ عن دور الدورة الزراعية الرباعية فى مكافحة الزمير مع اربع تعاقبات محصولية وأربع معاملات لمكافحة الحشائش فى ارض ذات عدوى طبيعية بالزمير (٦٢٤ بادرة /م٢) فى موسم ١٩٩١ / ١٩٩٢ . تم التوصل الى نتائج هامة عن دور التعاقب المحصولى الذى يشمل برسيم بالتبادل مع القمح أو البرسيم خلال ثلاث سنوات تعاقب متبوعة بقمح كانت اقل ملائمة لنمو الزمير واستزاف مخزون بذوره من التربة وزيادة انتاجية القمح ومكونات محصوله مع الحصول على تقاوى اقل تلوث ببذور الزمير مقارنه بالقمح الذى يزرع بدون دورة زراعية.

لهذا يوصى باتباع تعاقب محصول يشمل برسيم/قمح/برسيم متبوعا بنقاوة يدوية او استخدام المبيدات لمنع تجديد تلوث التربة ببذور الزمير، حيث ان هذا النظام يستزف مخزون بذور الزمير فى التربة مع المحافظة على انتاجية القمح الحالية مع التلوث ببذور الحشائش وتقليل استخدام المبيدات والمحافظة على البيئة من التلوث.